Institute for Advanced Development Studies

Development Research Working Paper Series

No. 01/2009

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April 2009

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First version: April 2009
This version: October 2009

Abstract:

This paper analyses non-agricultural work supplied by rural households in Bolivia. It is shown that roughly 50% of all rural households complement their incomes through non-agricultural work, but that households in the lowlands are more likely to do so than households in the highlands. Since non-agricultural work pays several times better than agricultural work, access to this source of complementary income constitutes an important opportunity to escape rural poverty.

JEL classification: J22, J43, R23, Q12.
Keywords: Rural labor markets, Bolivia, non-farm labor.

[*] This paper forms part of the project "Employment and Income in Peru, Bolivia and Paraguay: Analysis of the links between labor demand and supply in urban and rural areas." The authors greatly appreciate the funding provided by IDRC of Canada, as well as comments and suggestions provided by Albert Barry, Miguel Fernandez, Luis Carlos Jemio and Addy Suxo.

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1. Introduction

In the highlands of Bolivia, the agricultural growing season is quite short, spanning at most the 6 summer months (October-March), which also coincides with the rainy season. The remaining 6 months every year are characterized by high risk of frost and very little rain, which make most agricultural activities impossible.

Given the short agricultural season and the very low and volatile earnings derived from agriculture, one would expect these rural households to try to complement their incomes through non-agricultural wage-labor or non-agricultural self-employment. However, household surveys show that only about 47% of them manage to do so.

In the tropical Bolivian lowlands, on the other hand, agricultural activities are possible throughout the year. Still, a significantly larger percentage of the rural population engages in non-agricultural work (about 58%).

Given that non-agricultural work typically pays several times better than agricultural work in rural areas, one would expect rural families to try to secure as much non-agricultural work as possible. The fact that not all families are able to do so, suggests that there are constraints to accessing this kind of work. Constraints can be found either at the personal level (not having adequate education for non-agricultural work, for example) or at the local level (population too dispersed to create markets for non-agricultural products and services).

This paper examines the factors that encourage or limit rural households to engage in non-farming activities. Potentially relevant factors include: farm productivity, land holdings, herd size, number of days per year with frost risk, household size and composition, level of education, distance to nearest urban area with at least 10.000 inhabitants, population density, migration status, transfers received, etc.

The analysis uses both probit and OLS estimation and is done at the household level since all decisions and outcomes in a rural household are so thoroughly interdependent that it would be nearly impossible to sort out at the individual level.

The rest of the paper is organized as follows. Section 2 provides a short review of the relevant literature. Section 3 describes and compares rural work patterns and incomes for the three main eco-regions of Bolivia. Section 4 explains the probit estimation methodology and presents the estimation results. After presenting the discrete model explaining the decision whether to engage in non-agricultural work or not, we also present a continuous model explaining rural household incomes. Section 5 concludes.

2. Background and literature review

Due to the low income elasticity of agricultural products, total agricultural incomes are destined to decrease relative to non-agricultural incomes as the World grows richer. This basic fact has caused rural populations to gradually shrink compared to urban populations in virtually every country of the World, although some countries are more advanced in the process than others. As people leave agriculture, a process of consolidation can take place by which the remaining (or other newly arrived) farmers can buy up land, modernize and specialize thus increasing incomes to levels competitive with non-agricultural activities.

This basic long-run process leads to three associated processes. First, salaried work is becoming more common in agriculture, as the larger, more modern farms cannot operate on family labor alone. Second, non-agricultural rural work is becoming more common, as modern farming often spurs industrial development based on agricultural inputs, and since specialization requires people to trade instead of being self-sufficient in all areas. Third, more rural work is being done by people residing in urban areas, as modern farming requires more capital and more specialized knowledge, and the people who possess these assets will often reside in urban areas, which give them access to capital, services and markets.

These general processes are well-documented in Latin America (see, for example, Klein 1992; Dirven 1997; Reardon et al. 1998; and Ormachea & Pacheco 2000). In Bolivia, they seem to be present to different degrees in different parts of the country. In the following section, we will highlight some of the marked differences between agriculture in the Bolivian highlands and in the lowlands.

Reviewing a series of case studies, Reardon et al. (2006) conclude that in rural areas in Latin America, non-agricultural incomes are on average about 5 times larger than agricultural wages. As will be seen in the following section, this number is also roughly correct for the case of Bolivia, although our analysis suggests that the gap may be exaggerated due to the use of household survey data from a month that is not representative for the whole year.

Still, given the large gaps between agricultural and non-agricultural incomes, there are strong incentives for rural households to engage in non-agricultural activities. A number of studies have attempted to assess which factors determine rural households' ability to engage in non-agricultural activities[1]. Escobal (2001) finds that education is a key factor determining participation in non-farm activities in rural Peru. The importance of education is confirmed by Berdegué et al. (2001) for the case of rural Chile, by Janvry & Sadoulet (2001) for the case of Mexico, by Ruben and Van den Berg (2001) for the case of rural Honduras, by Corral & Reardon (2001) for Nicaragua, and by Lanjouw (2001) for El Salvador.

[1] All studies reported in this section use regression analysis to assess which factors are important in explaining rural households' participation in and earnings from non-agricultural activities.

Infrastructure and location relative to markets has also been shown to be important for the possibility of rural households to engage in non-agricultural activities. Isgut (2004) shows that non-agricultural salaried jobs in Honduras are mainly available close to urban areas, but that non-agricultural self-employment is geographically dispersed depending on specific assets, such as a tourist attraction or an important road. Corral & Reardon (2001) show that rural non-agricultural employment in Nicaragua is mainly concentrated close to Managua and other big cities on the Pacific side of the country, which is denser in population and infrastructure. Escobal (2005) demonstrates the importance of infrastructure in market development in rural Peru. In the case of rural Mexico, Janvry & Sadoulet (2001) found that market access is important for women's participation in off-farm work, but not for men's.

Land constraints would be expected to push farmers with too small landholdings into non-agricultural activities. This is indeed confirmed for almost all Latin American countries, as the *share* of rural non-farm income falls with the size of land (Reardon, Berdegué & Escobar, 2001). However, the *level* of rural non-farm income has been found to increase with the size of land holdings for Brazil (Graziano Da Silva & Del Grossi, 2001), Chile (Berdegué et al. 2001), Ecuador (Elbers & Lanjouw, 2001) and Peru (Escobal, 2001), and to have a U-shaped relationship in the case of Nicaragua (Corral & Reardon, 2001) and Panama (Wiens, Sobrado & Lindert, 1999). This suggests that land not only works as a constraint to agriculture, but also as an asset that facilitates the participation in non-agricultural activities.

One might expect larger families to be more likely to have at least one member engaged in non-agricultural work. The importance of family size for the participation in non-agricultural work has been investigated by several studies, but the evidence is rather mixed. Ruben & Van den Berg (2001) found a significantly positive effect of the number of adults on both non-farm wage employment and non-farm self-employment in Honduras, and a significantly negative effect of the number of children per adult (dependency ratio). Berdegué et al. (2001) did not find any significant effects of the number of economically active household members in rural Chile, and neither did Yúnez-Naude & Taylor (2001) for the case of Mexico, nor Lanjouw (2001) for the case of El Salvador. Ferreira & Lanjouw (2001) found a statistically significant negative effect of household size on the probability of a household in Northeastern Brazil to engage in high-productivity non-agricultural employment, but a significantly positive effect on the probability of engaging in low-productivity non-agricultural employment.

If a household receives significant transfers (pension payments, remittances, government subsidies, etc), the push to seek off-farm employment may be relieved. This hypothesis has been tested in several studies. Ruben & Van den Berg (2001) found a significantly positive effect from capital income and pensions, suggesting that this kind of non-labor income facilitates participation in off-farm activities rather than reduces the push. Government assistance was not found to have any significant effect. Berdegué et al (2001) found no significant effect from public subsidies in Chile on off-farm labor supply.

One final factor that has been investigated in the literature is migration. Here there are three different issues: 1) whether the migration status of the worker affects his probability of

engaging in off-farm work, 2) whether migrant household members have an effect on the household's probability of participating in non-agricultural work, and 3) whether migrant remittances affect household labor decisions.

As to the first issue, the evidence typically suggests that migrants are more likely to participate in off-farm activities than non-migrants[2]. For example, Ferreira & Lanjouw (2001) found that being locally born had a significantly negative effect on the probability of participating in non-farm work in the Brazilian rural Northeast.

Concerning the impact of having migrants abroad[3], the evidence is mixed. Janvry & Sadoulet (2001) investigated the issue in the case of rural Mexico and found that the number of siblings with US migration experience significantly increased the likelihood of participating in US seasonal work. Yúnez-Naude & Taylor (2001) also investigated the case of rural Mexico and found that having migrants abroad significantly reduced the propensity to engage in off-farm work in Mexico. This may be due both to the reduced labor force at home and to the remittances that migrants send back.

Reardon, Berdegué and Escobar (2001) reviews the importance of migrant incomes, and find them generally quite small, even in Mexico and Central America which rely heavily on migration. Yúnez-Naude & Taylor (2001), in their study of eight rural communities in Mexico, find that only 13% of incomes come from migration (both international and national), whereas 59% come from local non-farm incomes. Janvry & Sadoulet (2001), also for rural Mexico, find that 6.5% of incomes come from migration versus the 36% that come from earned non-farm income. In Ecuador at most 4% of incomes come from migrant remittances (Elbers & Lanjouw 2001) and in the case of Colombia the figure is only 2.5% (Echeverri 1999). These results suggest that local off-farm incomes are considerably more important than incomes from migration.

This short review of the literature on non-agricultural labor supply from rural households in other Latin American countries helps us to identify the variables that should be included in our econometric models in Section 4.

3. Rural work and incomes in Bolivia

The descriptive analysis presented in this section is based on the 2003-2004 continuous MECOVI household survey in Bolivia. The big advantage with this particular survey is that it has been spread out over a whole year spanning the period November 2003 to November 2004. This is in contrast to all previous and subsequent MECOVI surveys, which have been carried out in the course of only one or two months, and therefore are not representative with respect to rural work patterns, which vary tremendously throughout the year.

[2] Migrants are defined as persons born in another municipality than the one in which they are currently living, whereas non-migrants were born in the same place as they are currently residing.
[3] Family members who used to belong to the household, but were residing abroad at the time of the survey.

The incomes reported refer to all income generated in the households, both through salaried work and self-employment, including the value of consumption of the household's own production.

Table 1 shows the percentage of households that dedicated at least 1 hour to non-agricultural work in the week prior to the survey in the 2003-2004 survey and in the 2007 survey. While the percentages are quite similar between 2003-2004 and 2007 in the case of the valleys and lowlands, the 2007 numbers clearly underestimate non-agricultural activities in the highlands due to the 2007 survey having been conducted just in the beginning of the agricultural season in the highlands. Still, it is clear that participation in non-agricultural work is significantly lower in the highlands than in the lowlands. In this paper we will investigate whether this situation contributes to the higher levels of poverty in the rural highlands compared to the rural lowlands.

Table 1: Participation in non-agricultural work (% of rural households), 2003-4 and 2007

Eco-region	**2003-2004**	**2007**
Highlands	47.3%	36.1%
Valleys	51.4%	48.4%
Lowlands	57.8%	58.7%
Bolivia	50.6%	44.0%

Source: Authors' calculation based on MECOVI 2003-2004 and MECOVI 2007.

Reardon *et al* (2006), after surveying the results for several different LAC countries, conclude that non-agricultural work pays about 5 times more than agricultural work in rural areas in LAC (in terms of monthly incomes). This is confirmed in the case of Bolivia by Dirven & Kobrich (2007) who, using the MECOVI 2002, find that the former pays 6.7 times better than the latter, and by Valencia Rivamontan (2008) who, using the MECOVI 2007, finds that the former pays 8.7 times more than the latter on average.

The large differences are confirmed in Table 2 for the MECOVI 2007, but not for the continuous 2003-2004 household survey, which shows considerably smaller differences. This is most likely because all the other studies have used household surveys from one specific month (usually December) which exaggerates the difference between non-agricultural and agricultural work, both because December is sowing season (a lot of work but little income), but also because December is a particularly profitable and busy month in most kinds of non-agricultural work. This is in contrast to the information from 2003-2004, which is spread evenly across the year, and thus gives a more realistic picture of the differences in incomes and wages.

Table 2: Average income for agricultural and non-agr. work (Bs./hour), 2003-4 and 2007

Type of work	**2003-2004**	**2007**
Agricultural work	2,5	1,1
Non-agricultural self-employed work	3,2	9,2
Non-agricultural salaried work	6,2	6,0

Source: Authors' calculation based on MECOVI 2003-2004 and MECOVI 2007.

Table 3 shows how average hourly earnings vary through the year for people who work only in agriculture and for people who complement their income with at least one hour of non-agricultural work per week. In November and December there is a very large difference between the two in the highlands, with the latter earning 5.5 times more than the former. In contrast, in January and February, the latter only earns 54% more than the former. In general, earnings for highland people engaged only in agriculture vary tremendously throughout the year, with the best two months yielding hourly earnings that are 261% higher than the worst two months. The corresponding gap for the group that engages in some non-agricultural work is only 66%.

In the lowlands, agricultural earnings are much more stable throughout the year, with average hourly earnings in the best two months being only 81% higher than average hourly earnings in the worst two months. Also the gap in earnings between people engaged only in agriculture and those who participate in some non-agricultural work, is more constant throughout the year with the latter earning between 1.2 and 2.1 times more than the former.

Table 3: Average hourly income (Bs./hour), by season, activity, and region, 2003-2004

	Highlands		**Lowlands**	
Season	**Only Agriculture**	**Some Non-agricultural work**	**Only Agriculture**	**Some Non-agricultural work**
November – December	0.75	4.11	3.28	6.77
January – February	2.01	3.10	3.20	3.99
March – April	0.67	4.18	3.21	4.60
May – June	1.82	5.16	3.36	4.59
July – August	2.24	4.10	3.57	5.66
September – October	2.42	4.24	5.77	7.60
Average	1.98	4.47	3.78	5.30

Source: Authors' calculation based on MECOVI 2003-2004.

Table 4 shows average monthly per capita income in 2003-4 for households that participated in non-agricultural work and those that did not. It is clear that households, which participate in non-agricultural activities, no matter how little, have considerably higher incomes than households that depend exclusively on agricultural work. The premium is particularly large for households in the Valley region, as those who participate in non-agricultural activities earn 71% than those who do not. At the national level, the premium to rural households engaging in non-agricultural activities is about 53%.

Table 4: Average per capita income for rural households (Bs./month), 2003-2004

Eco-region	**Household did not do any non-agricultural work**	**Household did at least one hour of non-agricultural work**
Highlands	199,-	323,-
Valleys	241,-	445,-
Lowlands	307,-	482,-
Bolivia	232,-	424,-

Source: Authors' calculation based on MECOVI 2003-2004.

One would think that the households that dedicate more hours to non-agricultural work are the ones which achieve the highest monthly incomes, but this is not necessarily so. In the lowlands, it is the group that dedicates only between 1 and 20 hours per week to non-agricultural work which has the highest incomes, and in the highlands it is the group dedicating 21-40 hours per work (see Table 5). This suggests that while it is clearly beneficial to use non-agricultural work to supplement and smooth incomes, it can also be too much, withholding essential labor from relatively productive farm activities.

Table 5: Average monthly per capita income (Bs./month), by intensity of non-agricultural work in the household, 2003-2004

	Number of hours dedicated to non-agricultural work (per week)			
Eco-region	**0**	**1-20**	**21-40**	**41+**
Highlands	199,-	255,-	478,-	397,-
Valleys	241,-	280,-	316,-	536,-
Lowlands	307,-	637,-	450,-	448,-
Bolivia	232,-	329,-	442,-	457,-

Source: Authors' calculation based on MECOVI 2003-2004.

When discussing rural non-agricultural work it is useful to distinguish between primary occupations and supplementary work. Table 6 shows the distribution of main occupations of economically active rural inhabitants according to the 2001 Census, by region. While the highlands have a slightly higher proportion in agriculture and a slightly lower proportion in transportation and domestic services, there are not large differences in primary occupations. The main alternatives to agricultural activities are manufacturing industry, construction, commerce, education, transportation and domestic services.

Table 6: Main occupation of rural, economically active inhabitants, Census 2001

	Region		
Main occupation	**Highlands**	**Valleys**	**Lowlands**
Agriculture, cattle, fishing, etc	74.0%	70.3%	71.2%
Manufacturing industry	6.0%	7.5%	5.7%
Construction	3.9%	5.5%	3.8%
Commerce	4.2%	4.4%	4.4%
Education	3.4%	3.2%	3.2%
Transportation	1.5%	2.0%	2.5%
Domestic services	1.1%	2.5%	4.0%
Other	5.9%	4.6%	5.2%
Total	100.0%	100.0%	100.0%

Source: Authors' calculation based on the 2001 Census.

However, some of these activities can also be performed as supplementary activities by people whose main activity is agriculture, and it is in the access to these supplementary sources of income that we see the biggest regional differences. Table 7 indicates that households in the lowland and valley regions are more likely to engage in non-agricultural

secondary occupations and tend to spend more hours per month on these supplementary activities than households in the highland region. Basically, lowland households spend twice as many hours on supplementary non-agricultural work as highland households, and valley households three times as many hours.

Table 7: Participation in non-agricultural secondary occupations, 2003-2004

Eco-region	Share of households that engage in some non-agricultural work as a secondary occupation	Hours per week spent on secondary non-agricultural work
Highlands	12.0%	9.5
Valleys	22.4%	27.4
Lowlands	15.0%	17.9
Bolivia	16.1%	17.0

Source: Authors' calculation based on MECOVI 2003-2004.

Table 8 shows the earnings premium in each sector compared to agriculture for the different regions. Clearly, the premium in the education sector is much higher than the premium in the other sectors, which is due to the very different education requirements. At the national level, construction work pays about 23% more than work in the agricultural sector, but the premium is much higher in the highlands than in the lowlands. Indeed, in the lowlands, construction work pays less than agricultural work.

In the highlands, the premiums from working in other sectors than agriculture are typically higher than they are in the lowlands and valleys. For example, transportation pays a premium of 116% in the highlands but only 43% in the lowlands, and education pays a premium of 523% in the highlands but only 237% in the lowlands. The group "Other sectors" includes mining in the highlands and pays a premium of 154% whereas the premium for "Other sectors" in the lowlands is only 43%.

The high premiums for non-agricultural work in the highlands obviously reflect the low earnings from agriculture. But they clearly suggest that the incentive for seeking non-agricultural work is substantially stronger in the highlands than in the lowlands.

Table 8: Index of earnings per hour (agriculture = 1), by sector, 2003-2004

	Region			
Sector	**Highlands**	**Valleys**	**Lowlands**	**Bolivia**
Agriculture, cattle, fishing, etc	1.00	1.00	1.00	1.00
Manufacturing industry	1.26	1.23	0.95	1.20
Construction	1.44	1.41	0.89	1.23
Commerce	1.03	1.22	1.07	1.08
Education	6.23	4.89	3.37	4.83
Transportation	2.16	1.80	1.43	1.81
Domestic services	1.15	0.39	0.55	0.57
Other sectors	2.54	1.89	1.23	1.91

Source: Authors' calculation based on the 2003-4 MECOVI.

As suggested above, the higher levels of income in non-agricultural work are related to higher levels of education. Especially in the highlands is there a big difference, with non-agricultural workers having almost twice as many years of education as agricultural workers. In the lowlands, the difference is much smaller with non-agricultural workers having only 1.5 years more education than agricultural workers (see Table 9).

Table 9: Average years of education for agricultural and non-agricultural workers, 2003-2004

Eco-region	Agricultural workers	Non-agricultural workers
Highlands	4.0	7.6
Valleys	3.8	5.7
Lowlands	4.9	6.4
Bolivia	4.0	6.7

Source: Authors' calculation based on MECOVI 2003-2004.

Table 10 shows the impact of education on monthly household incomes. There is no significant difference in per capita incomes between households that have only a very rudimentary level of education (0-4 years) and those that have at least one member with completed primary school and perhaps some secondary education too (8-11 years). This means that primary education has little impact on incomes in rural Bolivia. A household needs at least one person with complete secondary education in order to substantially increase incomes. The very low returns to primary education in rural areas of Bolivia have been confirmed by other empirical studies, such as Escalante (2004) and Sanchez (2005). This suggests that the lack of post-primary education is likely a constraint to access to non-agricultural work, and in Section 4 we will formally test this hypothesis in a regression framework.

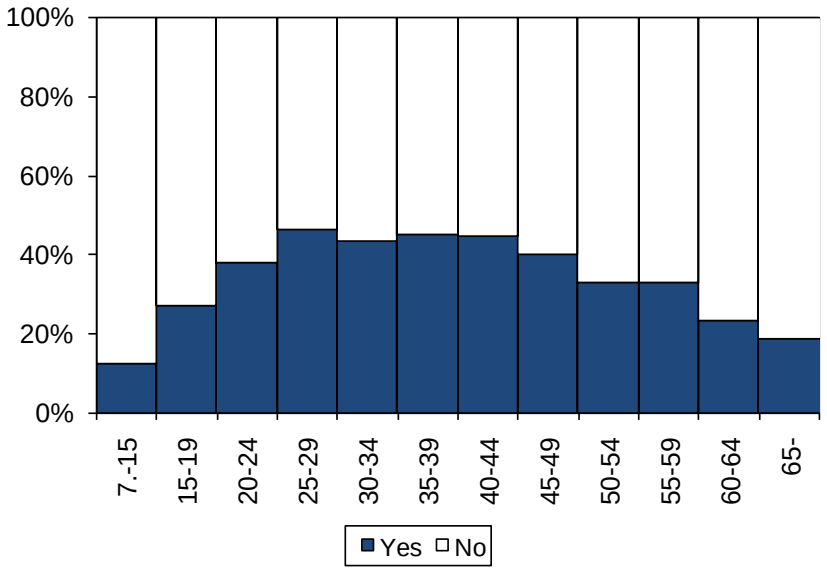
Table 10: Average monthly per capita income (Bs./month), by highest education level in household, 2003-2004

	Years of education for most educated family member			
Eco-region	**0-4**	**5-7**	**8-11**	**12+**
Highlands	218,-	198,-	207,-	793,-
Valleys	278,-	197,-	305,-	1230,-
Lowlands	302,-	282,-	335,-	879,-
Bolivia	251,-	214,-	267,-	915,-

Source: Authors' calculation based on MECOVI 2003-2004.

Finally, Figure 1 shows that it is mainly prime-aged individuals (20-50 years) who participate in non-agricultural work, while the young and the old tend to limit themselves to agricultural activities. Men and women are equally likely to engage in non-agricultural work.

Figure 1: Share of working rural population who engages in non-agricultural work, by age group, 2003-2004



Source: Authors' calculation based on MECOVI 2003-2004.

4. The determinants of non-agricultural work in rural Bolivia

Following Sumner (1982), we estimate a probit model of the participation equation. The estimation is done at the household level, since all decisions and outcomes in a rural household are so thoroughly interdependent that it would be nearly impossible to sort out at the individual level. The dependent variable is a dummy that take the value 1 if the household has dedicated at least 1 hour to non-agricultural work the week before the survey, and zero otherwise.

Theory suggests that all variables that affect the marginal value of time in either agriculture or non-agriculture should be included in the regression. The variables have been grouped into two groups: household characteristics and location characteristics.

AGE and AGE^2 represent general experience and physical capacity of the head of the household and show a hump-shaped profile over the life cycle in most kinds of work, but the hump is perhaps more pronounced for salaried employment than self-employment. EDUCATION measures the highest education level obtained in the household[4]. Education

[4] We use the highest education level obtained in the household rather than the education of the head of household, as the head of household often by convention is the oldest male in the household, and his education level (often close to 0 years) is less clearly associated with household incomes and activities than the education level of the most educated member of the family.

increases the returns for all kinds of work, but probably more for non-agricultural work than agricultural work, so we would expect increased education levels to increase the probability of participating in non-agricultural work. We also include $EDUCATION^2$ to allow for non-linear returns to education. CHILDREN measures the number of children below the age of 10, and the effect on participation in non-agricultural work would be expected to be negative, as the burden of caring for children may reduce the time available for off-farm labor. ADULTS measure the number of people aged 10 or more. This variable would be expected to have a positive effect on participation as these persons would be available for both farm and non-farm work. INDIGENOUS is a dummy which takes the value 1 if the first language of the head of household is one of the indigenous languages of Bolivia. This variable may affect participation if employers discriminate against indigenous people. TRANSFERS is the natural logarithm of all non-labor incomes. The availability of such "easy" income would be expected to reduce labor supply in general and participation in non-agricultural work in particular.

In the second group of explanatory variables are regional dummies, which capture the general differences in climate and agricultural conditions. The variable DISTANCE measure the logarithm of the distance to a major urban center (more than 10.000 inhabitants). ROADDEN measures the density of roads in the municipality, and would be a proxy for the quality of infrastructure in the locality. FROST measures the number of days per year with risk of frost, and is considered a push factor that would increase the probability of participation in non-agricultural activities.

There are two variables which we would have liked to include in the model (a MIGRANT dummy and a LANDSIZE variable), but these could not be generated from information in the 2003-2004 MECOVI survey, so they had to be ignored.

Table 11 shows the regression results for the whole country.

Table 11: The determinants of participation in non-agricultural work, 2003-4 (dprobit with participation in non-agricultural work as the dependent variable)

Explanatory variable	**Coefficient**	***(z-value)***
AGE	0.0202	*(3.96)*
AGE^2	-0.0002	*(-4.09)*
EDUCATION	0.1286	*(1.20)*
$EDUCATION^2$	0.0018	*(2.68)*
CHILDREN	0.2304	*(2.02)*
ADULTS	0.0008	*(0.08)*
INDIGENOUS	-0.0615	*(-1.55)*
TRANSFERS	-0.0075	*(-1.24)*
DISTANCE	-0.0080	*(-0.42)*
ROADDEN	0.0541	*(3.44)*
FROST	0.0216	*(0.49)*
# obs = 1888		**Pseudo R^2 = 0.1120**

Source: Authors' estimation based on MECOVI 2003-2004.

The results indicate that the probability of participating in non-agricultural work depends on the age of the head of household, the highest level of education in the household, the number of children, and the density of the road network in the municipality where the family resides. The remaining variables were found to be statistically insignificant.

One of the main purposes of this paper is to test whether the restrictions of access to non-agricultural work differ between regions. In Table 12 we report the same probit regression separately for the highlands, the valleys, and the lowlands.

Table 12: The determinants of participation in non-agricultural work, by region, 2003-4

	Highlands	**Valleys**	**Lowlands**
Explanatory variable	**Coefficient** ***(z-value)***	**Coefficient** ***(z-value)***	**Coefficient** ***(z-value)***
AGE	0.0375	0.0210	0.0005
	(4.49)	*(2.50)*	*(0.05)*
AGE^2	-0.0004	-0.0002	0.0000
	(-4.58)	*(-2.62)*	*(0.05)*
EDUCATION	-0.0034	-0.0076	0.0115
	(-0.18)	*(-0.35)*	*(0.53)*
$EDUCATION^2$	0.0026	0.0037	0.0013
	(2.26)	*(2.48)*	*(0.98)*
CHILDREN	0.0424	0.0444	0.0176
	(1.95)	*(2.36)*	*(1.10)*
ADULTS	0.0120	0.0029	0.0059
	(0.56)	*(0.14)*	*(0.40)*
INDIGENOUS	-0.0808	0.0107	-0.1622
	(-0.88)	*(0.13)*	*(-2.71)*
TRANSFERS	-0.0385	-0.0130	0.0098
	(-3.13)	*(-1.24)*	*(1.23)*
DISTANCE	0.2844	-0.0022	-0.0444
	(2.85)	*(-0.10)*	*(-1.44)*
ROADDEN	-0.0626	0.3205	0.04340
	(-0.44)	*(1.25)*	*(3.99)*
FROST	-0.0745	-0.0451	0.0601
	(-0.77)	*(-0.56)*	*(0.91)*
	# obs = 604	**# obs = 621**	**# obs = 663**
	Pseudo R^2 = 0.2384	**Pseudo R^2 = 0.1383**	**Pseudo R^2 = 0.0808**

Source: Authors' estimations based on MECOVI 2003-2004.

The regional results reveal some interesting differences between the highlands and the lowlands. In the lowlands, road density is the most important variable affecting the probability of participating in non-agricultural work, whereas education is insignificant. In the highlands and the valleys the opposite is true: the probability of non-agricultural work increases exponentially with education, whereas road density was found to be insignificant.

In addition, transfers received discourages non-agricultural work in the highlands, whereas in the lowlands it has no such discouraging effect, and even tends towards a positive effect, although with the small sample size the coefficient is not statistically significant at the 95% level.

These differences reflect the structural differences in the rural economies of the highlands and the lowlands. In the highlands, subsistence farming is still dominant, and rural families are to a large extent self-sufficient, which implies a very limited service sector. The few non-agricultural jobs that can be found are mainly public sector jobs requiring substantial education (teachers, doctors, municipal administration, aid projects, etc). In contrast, the lowlands have a modern agricultural sector, which generates a large number of agro-industrial and service sector jobs which do not require higher education.

The modern agricultural sector in the lowlands is sufficiently dynamic to generate jobs and wealth, but is limited by binding infrastructure constraints. In the highlands, on the other hand, transport infrastructure does not appear to be a binding constraint. Instead, the constraints are the availability of non-agricultural jobs and the education that these jobs would require. In the lowlands, the private sector can generate jobs, as long as the government provides infrastructure, but in the highlands, people rely on public sector jobs to pull them out of subsistence farming.

The valley region is an intermediate case, but more similar to the highlands than to the lowlands.

The final regression reported in Table 13 explains rural per capita household incomes in the whole country. As expected, participation in non-agricultural work boosts income substantially (about 30%). When controlling for all other factors, lowland families earn about 47%[5] more than highland and valley families. Frost has an additional negative effect on rural incomes. Each additional child reduces per capita household incomes substantially, which is natural as household income gets divided by more persons. Additional adults also reduce per capita household incomes, but not as much as additional children. Indigenous families have lower per capita household incomes, even when controlling for their typically lower participation in non-agricultural work, their lower education levels, the larger family size, and the tendency to live in the coldest parts of the country.

Table 13: The determinants of log rural per capita household income, 2003-4

Explanatory variable	**Coefficient**	***(t-value)***
NON-AG WORK	0.2613	*(5.08)*
AGE	0.0094	*(1.44)*
AGE^2	-0.0000	*(-0.19)*
EDUCATION	-0.0631	*(-3.51)*
$EDUCATION^2$	0.0075	*(7.62)*
CHILDREN	-0.1679	*(-9.30)*

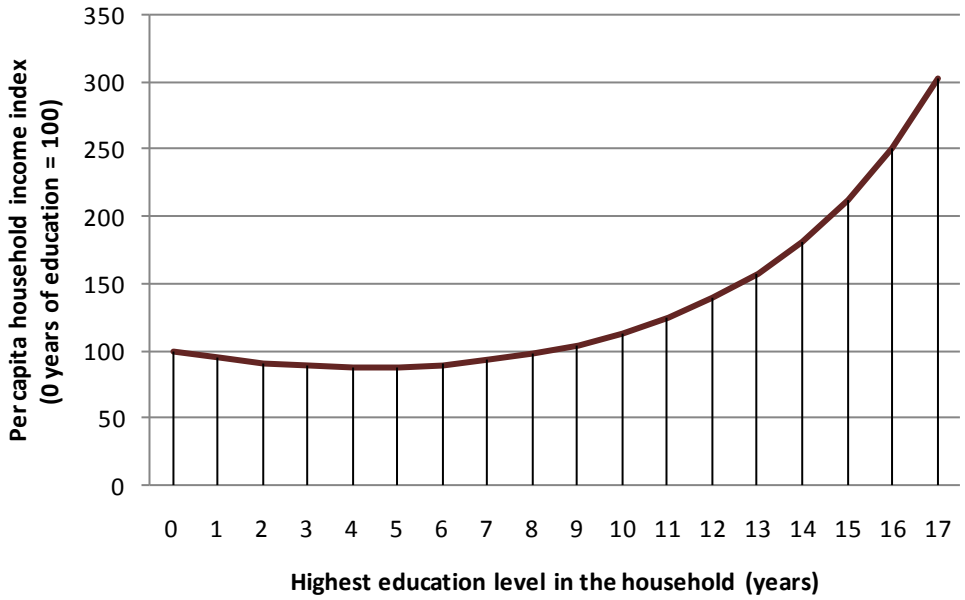
[5] Calculated as: exp(0.3868) – 1.

ADULTS	-0.0626	*(-3.27)*
INDIGENOUS	-0.2152	*(-3.73)*
DISTANCE	0.0027	*(0.11)*
ROADDEN	-0.0491	*(-1.25)*
FROST	-0.2001	*(-2.91)*
HIGHLANDS	0.0229	*(0.28)*
LOWLANDS	0.3868	*(5.00)*
CONSTANT	5.4778	*(28.46)*
# obs = 1888		**R^2 = 0.3431**

Source: Authors' estimation based on MECOVI 2003-2004.

Finally, education is extremely important, in a non-linear way. Figure 2 shows how per capita household income increases exponentially with the highest level of income in the family. Unfortunately, the economic benefits of education do not start materializing until post-primary education.

Figure 2: The relationship between education levels and household income p.c., 2003-4



Source: Authors' estimation based on MECOVI 2003-2004.

5. Conclusions

This paper has argued that only the continuous 2003-2004 MECOVI survey is appropriate for an analysis of rural labor markets, since all other MECOVI surveys are not representative for the whole year, but only for the survey month (usually December), which is unusual both for the agricultural sector and the non-agricultural sectors. In the agricultural sector, December is sowing season which implies a lot of work and little income, and in the non-agricultural sector it is a month of considerable extra sales and

earnings for most of the self-employed sector due to Christmas. We show that according to the 2003-2004 survey, the differences in income between non-agricultural work and agricultural work is only a factor 2-3, whereas previous research using other MECOVIs indicates that the former earn 5-8 times the latter per month.

Using the appropriate 2003-2004 survey, we have shown that primary education has little effect on rural incomes. Rural households need to have at least one person with completed secondary education in order to earn significantly more than households with only rudimentary education. If they do have at least one member with completed secondary education, monthly per capita household incomes increase dramatically (by a factor of 3-4 compared to households who do not have any members with completed secondary education), and this is mostly because secondary and post-secondary education gives access to non-agricultural work.

The extra education needed to gain access to non-agricultural work is much larger in the highlands than in the lowlands, however. In the highlands, people working in the non-agricultural sector on average have 3.6 years more education than people working in agriculture. In the lowlands, the difference is only 1.5 years. This means that the widespread lack of secondary education is much less of an impediment to finding non-agricultural work in the lowlands than it is in the highlands.

The main reason for this difference is that the lowlands have a more modern and market oriented agricultural sector, which generates a considerable amount of part-time non-agricultural jobs, whereas the rural highlands are characterized by subsistence agriculture with fewer links to the regional economy. This means that the few non-agricultural jobs in the highlands are typically full-time public sector jobs (teachers, doctors, public administrators), which require advanced education, whereas in the lowlands there are plenty of non-agricultural jobs related to the transportation and processing of agricultural output, construction, commerce, and other activities, which require less formal education.

Road infrastructure was found to be a binding constraint for access to non-agricultural jobs in the lowlands, but not in the valleys and the highlands. This means that the already relatively prosperous rural sector in the lowlands would likely benefit from additional public investment in infrastructure, whereas it is more doubtful whether such investments would be beneficial in the highlands. Indeed, the results indicate that it is difficult to boost rural incomes in the highlands. Road infrastructure apparently has little effect, and education only starts having a positive effect at post-primary levels. Finally, non-labor incomes actively reduce incentives to look for complementary non-agricultural work in the highlands.

This indicates that highland rural households are dependent on the government creating jobs for them to pull them out of subsistence agriculture and poverty. The private sector does not have the dynamism to do this by itself, so the government needs to identify possible motors of rural non-agricultural development in the highlands. Mining has been the traditional choice, but there are also other options, such as tourism. The highlands have some spectacular tourist destinations, which are very under-exploited. The Uyuni Salt Flats, for example, could attract millions of tourists if there were any decent tourist facilities

(hotels, restaurants, guides, activities, transportation, souvenir shops, etc.), and such activities would generate a large variety of jobs, most of which do not require university education.

The international cooperation, which is very active in the Bolivian highlands, need to overcome its agricultural bias, and venture into non-agricultural activities, which have more potential for pulling people out of poverty. For decades the cooperation has been trying to increase agricultural productivity in the highlands, seemingly oblivious to the fact that when demand is fixed, an increase in productivity will just cause prices to fall, leaving the farmer no better off. People in the highlands are already intimately familiar with agricultural tasks, as that is what they have been doing for centuries, but they have little knowledge about the type and quality of services that tourists would demand, and therefore they cannot launch such projects without help.

Due to a widespread lack of property rights and land titles, many farmers are tied to their plot, and could not sell it and switch to a more profitable job or location even if they wanted to. Just helping rural landholders to get titles to their land could help modernize the agricultural sector, as it would allow some people to leave the sector without having to abandon their only asset. At the same time others could consolidate the lands and create modern farms of optimal size, and at the same time generate employment for others.

Local governments also have to play a very active role in this process of integrating rural and urban activities, and softening the currently stark contrasts. Well-managed small towns can work as magnets on the younger generations of rural inhabitants by providing education facilities, job opportunities, entertainment, and full access to basic services. If there is not an attractive urban center in the region, young people may well choose to move to a big city in search of opportunities, in which case the local area tend to enter a vicious circle of brain drain and stagnation.

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